IN THE UNITED STATES PATENT AND

TRADEMARK OFFICE

In re Application of: Atkinson et al.	)	
	)	Examining Group No. 3641
Serial No.: 09/864,339	)	
	)	Examiner: Edward A. Miller
Filed: May 25, 2001	)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER RULE 132

Dear Sir:

I, Dr. Don H. Cranney, hereby declare as follows:

1. I am the Explosives Products Manager in Dyno Nobel Inc.'s Research, Technology and Engineering Department. Dyno Nobel Inc. is the assignee of the above-captioned U.S. patent application (the "application") and is a major manufacturer in the United States of

commercial explosives, including emulsion blasting agents of the type described in the specification of the application.

2. My education background includes a Bachelor of Science degree in Chemistry from Brigham Young University in 1969. In 1976, I received a doctorate degree in Analytical Physical Chemistry from Brigham Young University. In March 1980, I became employed in the explosives industry and from then to the present time have conducted and supervised the conducting of research and product development of emulsion explosives of the type described in the application and thus, during that time, have become familiar with the general level of knowledge of those having ordinary skill in this art.

3. I have reviewed the specification and present claims of the application, the previous office actions filed in this case and the responses by Applicants thereto, Applicants' Brief in Reply, the current office action mailed April 23, 2004, and the references cited by the Examiner.

4. The invention relates to a water-in-oil emulsion blasting agent (or in common terms an "explosive") that comprises an inorganic oxidizer salt solution as a discontinuous phase and an organic liquid fuel as a continuous phase of the emulsion (both

phases together commonly are referred to as the "emulsion phase"). More particularly, the invention relates to a method of variably reducing the energy of the emulsion blasting agent by the addition of an energy reducing agent (water or aqueous solution) in a way that does not destabilize the emulsion phase. Emulsion blasting agents or explosives typically are used for fracturing or displacing rock, ore or overburden in mining and construction applications.

5. A water-in-oil emulsion is an intimate dispersion of discrete, fine droplets of water or aqueous solution (in this case an inorganic oxidizer salt solution) in a continuous oil phase that forms a thin film of oil around each droplet. An emulsifier is present in minor amount as a surface active agent to help keep the phases separate and the droplets dispersed. A commonly known water-in-oil emulsion is margarine or butter. In an emulsion blasting agent, the weight ratio of the droplets to oil is roughly 94:6, and the volume ratio is roughly 90:10. A cross-section of an emulsion phase would look somewhat like a cross-section of a beehive, with the walls of the beehive honeycomb structure representing the continuous oil phase and the hexagonal cells representing the solution droplets.

6. This emulsified state is thermodynamically and inherently unstable, since the droplets want to coalesce and the dissolved salts in the droplets become supercooled (following formation of the emulsion at a temperature above the crystallization temperature of the inorganic oxidizer salt solution) and thus want to crystallize. Either of these events can cause a breakdown of the emulsion phase and consequent desensitization of the emulsion blasting agent to detonation. (This desensitization occurs because the oxidizer molecules from the inorganic oxidizer salt solution droplets and the fuel molecules from the organic liquid continuous oil phase are no longer as intimately in contact with each other and thus cannot react as readily to produce an explosive reaction.)

7. Maintaining a stable and thus sensitive emulsion phase is a ongoing struggle in the explosives industry, particularly when the emulsion phase is subjected to shear stress during transfer or loading operations (such as when pumping the fluid emulsion blasting agent from one container to another or into a borehole) or when additional ingredients are added and mixed into the emulsion phase (such as energizing aluminum particles or sensitizing glass microballoons). These dynamic operations can cause or accelerate the breakdown of the emulsion phase.

8. The method claimed in the claims of the application provides a way in which an energy-reducing agent (water or aqueous solution) can be added and dynamically mixed into the emulsion phase to reduce significantly the energy of the emulsion blasting agent without destabilizing and desensitizing it.

9. Independent claim 10 contains a method "of reducing the energy of an emulsion blasting agent as it is being loaded into a borehole" comprising the steps of selecting an emulsion blasting agent as specified, conveying the emulsion blasting agent, adding an energy-reducing agent (water or aqueous solution) to the emulsion blasting agent as it is being conveyed, mixing the energy-reducing agent uniformly and homogeneously into the emulsion blasting agent in the claimed amount "to form a second discontinuous phase," adding gassing agents and loading the conveyed emulsion blasting agent into a borehole. By adding the energy-reducing agent as a second discontinuous phase, the emulsion blasting agent is found to retain its sensitivity and stability, which would not be the case if the significant amounts of water or aqueous solution as taught in the specification were combined initially with the inorganic oxidizer salt solution or if the water or aqueous solution were added in a manner that did not form a second discontinuous phase.

10. Dependent claim 15 specifies that the borehole is a perimeter borehole, which as explained in the specification on pages 2-4, makes the invention particularly advantageous since perimeter boreholes can be loaded with a less energetic emulsion blasting agent, while the internal boreholes in the pattern can receive a more energetic load, both from the same base emulsion blasting agent formulation. This versatility is highly desirable.

11. Dependent claim 16 further allows for energy and density variation throughout the length of a given borehole, also advantageous as explained in the full paragraph on page 4 of the specification.

12. In essence, the claimed invention provides a way to reduce significantly the energy of an emulsion blasting agent without desensitizing or destabilizing it. Simply adding from about 5% to about 22.5% by weight of additional water or aqueous solution to an emulsion blasting agent, without forming a second discontinuous phase, would be detrimental if not fatal to the performance of the explosive.

13. The limitations in independent claim 10 distinguishes it from the prior art. The claim requires that the energy-reducing agent, either water or an aqueous solution, be mixed

uniformly and homogeneously into the emulsion blasting agent "to form a second discontinuous phase." This is not just "watering down" an explosive, rather, it is an inventive way of adding water to an explosive to reduce its energy without desensitizing or destabilizing it. This is not disclosed, suggested or implied in any of the references cited by the Examiner.

14. Lawrence et al., Engsbraten and Waldock all disclose adding "dry" ingredients to an emulsion phase. See Lawrence et al., col. 2, lines 55-59; Engsbraten, col. 2, lines 46-49; and Waldock, col. 3, lines 57-62. Although Lawrence et al. disclose that the proportion of ingredients being blended to form a slurry blasting agent (which has a continuous aqueous phase) can be varied as the composition is being delivered into the borehole (col. 1, lines 42-54), they disclose in col. 2 adding only dry ingredients to an emulsion blasting agent. Engsbraten discloses the use of porous, non-aqueous, bulk fillers (solids) as his energy-reducing agent. Once combined with an emulsion phase, the mixture becomes non-pumpable. Further, the emulsion phase in Engsbraten is used in an amount only sufficient for improving adherence between the particulate oxidizer salt and the particulate filler. Waldock similarly uses an inert bulking agent to vary the energy in his composition. This inert, solid bulking agent behaves as an energy

diluent, decreasing the "shock" energy by absorbing heat and not providing additional work energy during detonation.

15. In contrast, claim 10 requires the addition of an energy-reducing agent in the form of water or aqueous solution. Step d) of claim 10 further requires that the liquid energy-reducing agent form a second discontinuous phase in the water-in-oil emulsion phase. The cited references do not disclose the addition of a liquid, water-based energy-reducing agent in the claimed amount to an already formed emulsion blasting agent and that such energy-reducing agent be mixed uniformly and homogeneously into the emulsion blasting agent "to form a second discontinuous phase." These distinctions and order of addition of the energy-reducing agent are significant.

16. As explained in the specification on page 5, lines 7 et seq.:

> The present invention differs from this prior art in that the water or aqueous solution added to the emulsion blasting agent in the present invention is added to the emulsion blasting agent in an amount sufficient to reduce significantly its energy and is mixed uniformly and homogeneously throughout the emulsion phase. In fact, when mixed in this manner the water or aqueous solution forms a second discontinuous droplet phase to that formed by the initial oxidizer salt solution component. This second discontinuous phase renders the emulsion blasting agent more sensitive and stable than if the water or aqueous solution were combined initially

with the inorganic oxidizer salt solution or if they were not mixed uniformly and homogeneously throughout the emulsion phase. (Emphasis supplied.)

17. Even though the final composition contains a considerable amount of water, it remains stable and detonable over time because the additional water is in the form of a second discontinuous phase. If that amount of water simply were added to the aqueous salt solution used to form the emulsion phase, the same detonability would not be achieved.

18. By mixing this high amount of water or aqueous solution uniformly and homogeneously into the emulsion blasting agent to form a second discontinuous phase, the emulsion remains reliably detonable. For example, mix 4, described on page 12 of the specification, and in Tables 1 and 2 on page 13, sat for one hour before being detonated but remained reliably detonable even when its volume energy was reduced by about 55% and as much as 20% by weight water was added and mixed uniformly and homogeneously into the composition.

19. The order of addition of the water or aqueous solution energy-reducing agent is important. The energy-reducing agent must be added to an already formed emulsion blasting agent in order for

the energy-reducing agent to form a second discontinuous phase within the emulsion phase of the emulsion blasting agent.

20. Another advantage of the claimed invention is that the energy-reducing agent reduces significantly the shock to bubble energy ratio of the emulsion blasting agent. As explained on page 12 of the specification:

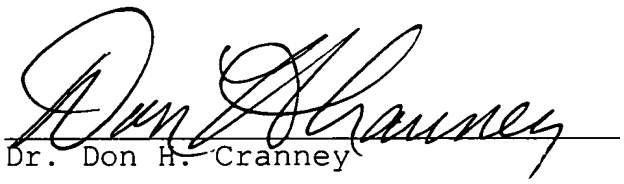
> The shock to bubble energy ratio changed from about 56/44 with standard emulsion blasting agent (mix 1) to about 40/60 for gassed emulsion blasting agent with 20% energy-reducing agent (mix 4). This shift in energy from shock to bubble is highly desirable in blasting operations where wall and perimeter control is required.

The Lawrence et al., Engsbraten, and Waldock references, which all add solid ingredients, do not teach or disclose this beneficial effect of decreasing the shock to bubble energy ratio.

21. Although Patterson et al. disclose an emulsion composition having a second discontinuous phase, the second discontinuous phase is added as an emulsion, not water or aqueous solution, and thus the resulting composition is a blend of two emulsions. Moreover, the second emulsion phase is added principally to increase stability of the composition, particularly when AN prills are used. (See col. 4, lines 9-19.) Finally, the

second emulsion phase is not added as the emulsion blasting agent is being loaded into a borehole, as required in claim 10.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and furthermore that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



Dr. Don H. Cranney